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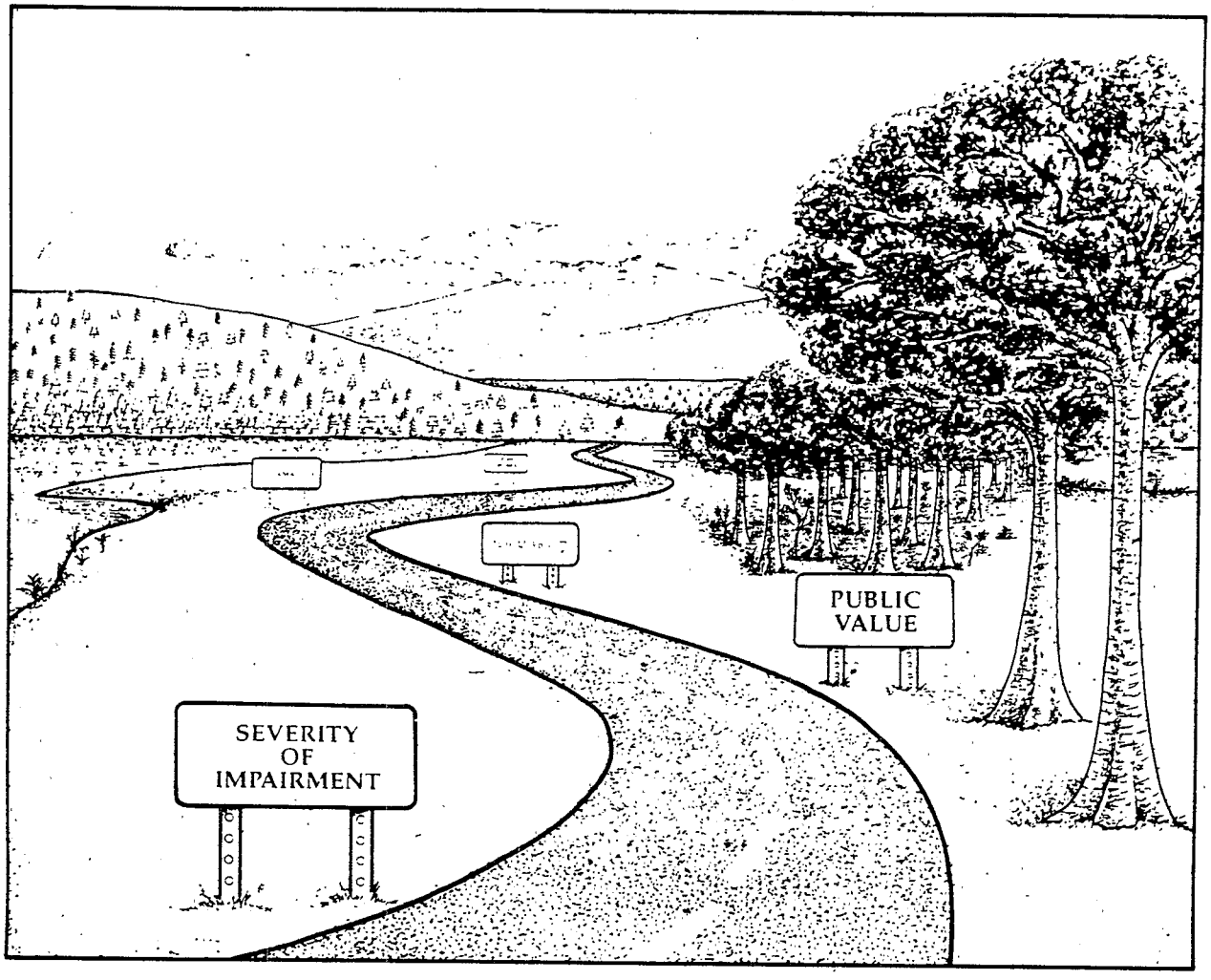
Selecting Priority Nonpoint Source Projects:

You Better Shop Around



SELECTING PRIORITY NONPOINT SOURCE PROJECTS: YOU BETTER SHOP AROUND

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Conclusions for Selecting NPS Demonstration Projects

1. Water quality managers should use ranking methodologies to help form a consensus opinion on a state's priority NPS water bodies based on a combination of objective water quality, economic and political criteria. We believe that forming a consensus is more useful than the final scores assigned each water body. While developing consensus may take more time initially, it provides for much more efficient implementation over the long term.

2. Ranking systems should be used to identify potential NPS projects that could succeed in producing the greatest public benefit--given available resources. None of these systems, however, are capable of removing all uncertainty from the project selection process. Therefore, the final decision to proceed with a project should be based on a more in-depth watershed assessment and willingness of local land owners to participate.

3. Ranking systems should be used to identify water bodies that lack sufficient information and data for an initial ranking. New Mexico goes one step further by ranking water bodies that require additional information collection. This process can easily be incorporated into other state programs.

4. Most states are more advanced in prioritizing their lakes than other water bodies. This is probably due to the visible constituency for lake resources and the experience of the Clean Lakes Program. Where appropriate, states should adapt lake priority ranking methodologies to address streams, wetlands, and estuaries.

5. Ranking systems help organize large sets of diverse data from across a state and across many different disciplines. They allow water quality managers to integrate severity of impairment with likelihood of success, potential public benefits, and other factors important to the state.

6. Biological indices are an integral part of most state ranking systems, however, biological indices are not always easy to interpret and sufficient data is a problem in some cases. As a result, water quality managers who are responsible for ranking water bodies should work closely with the scientists familiar with the application of these indices.

7. Increased land disturbance in the proximity of an unpolluted water body can indicate a potential water quality impairment. By monitoring changes in land use activity around high value unpolluted water bodies, it is possible to prepare for or prevent future NPS problems in the current planning cycle

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PREFACE

Section 319 of the 1987 Water Quality Act provides local, state, and federal agencies with a new mandate and opportunity to restore the beneficial uses of streams, lakes, wetlands, and estuaries impaired by nonpoint source (NPS) pollution. The Act also provides a stimulus to modify land use activities that threaten to impair water bodies. Approximately 25 percent of the Nation's waters do not meet state designated uses for drinking, swimming, boating, or other uses. Of these impaired waters, NPS pollutants are cited as the cause of impairment in 75 percent of lake acres, 65 percent of stream miles and 45 percent of estuarine acres (U.S. EPA, 1987a). Implementation of the Act requires states to identify their NPS impaired and threatened water bodies, and provides states the opportunity to develop NPS Management Programs over the next four years to address their highest priority problems.

Congress authorized $400 million for fiscal years 1988 through 1991 to help states implement section 319, however, actual appropriations were zero in FY 1988 and FY 1989, and future appropriations remain uncertain. Other EPA funds are available, however, including sections 205(j)(5) and 106, the governor's discretionary funding under section 201(g)(1)(b), and the State Revolving Fund under section 603(c)(2). In addition, the Food Security Act of 1985 and USDA's water quality initiative redirect large quantities of resources and personnel towards addressing water quality problems created by agricultural activities, and it is anticipated that this will continue in the 1990 Food Security Act. However, it is the responsibility of the states and Federal land management agencies to manage their NPS problems, show how NPS controls can improve and protect water quality, and demonstrate the importance of long-term NPS control efforts.

Section 319 of the Act clearly outlines the basic program elements that each state and Federal land management agency must conduct to achieve the goals of the Act. These responsibilities are: 1) complete an assessment of all state navigable waters impacted by NPS pollution; 2) develop a management program to provide direction and efforts to address NPS and to provide a specific strategy to solve selected NPS problems in specific geographic areas; and 3) the state must provide a framework and schedule to implement the state NPS Management Program.

A very critical step in the success of state NPS programs depends on how efficiently available resources are targeted to priority water bodies. This manual provides examples of how several states have selected their NPS projects to seek maximum public benefits from limited public resources. Central to the selection processes reviewed is the consideration of: 1) severity or threat of impairment, 2) public value of the water body, 3) resolvability of NPS impairment, and 4) availability and quality of assessment information. States use a variety of indices and indicators to evaluate these four criteria for their water bodies. Adaptation of these processes, indices, and indicators to your state program should be done carefully to insure that the results reflect accurately the NPS impairments and the best treatment priorities. While good planning will not solve all NPS problems (money is also needed for program implementation), it is needed to ensure that available resources are efficiently spent.

Introduction

This manual presents six examples of how states identify their priorities for treatment of impaired or threatened water bodies. These case studies are intended to help you as a water quality manager to develop or refine your own process for ranking NPS impaired or threatened water bodies. This manual does not provide "cookbook" approaches to ranking water bodies. Rather, it provides examples that you may modify to suit your state's approach to managing NPS pollution.

State and federal water quality managers are encouraged to use or adapt these examples to their state NPS management programs where appropriate so that selected projects: 1) restore the greatest beneficial uses at a reasonable cost, and 2) increase the likelihood of a successful NPS project--given available resources and program authority.

Priority ranking is important because sufficient public funds do not currently exist to address all significant NPS problems. Focusing public funds on priority water bodies improves the chance of producing visible water quality improvements (U.S. EPA, 1987b). In turn, demonstrated water quality improvements can help generate additional public support, which is one of the key ingredients for long-term support of NPS abatement.

State Priority Ranking Systems

About 35 states currently use a formal process for prioritizing their water quality or natural resource programs (not necessarily in their NPS program). The six systems (IL, OH, NY, NM, RI and CO) discussed here were selected because they can address NPS pollution problems and represent the unique aspects of the other 29 state ranking processes.

Priority ranking systems vary substantially in their complexity and in the amount of data required to employ them. Some states, like New York, have an extensive collection of water quality and water use data, and their ranking system has the sophistication to use these data. Where data collection is less complete, using a decision tree like New Mexico's may be more useful because it allows water quality managers to prioritize water bodies with far less data. While most systems discussed in this manual rank water bodies for protection or restoration, New Mexico's system also ranks water bodies for additional information collection. New Mexico focuses resources for information collection on those water bodies that could produce the largest public benefit.

Illinois' ranking system is typical of the systems reported here that use numerical scores to rank their lake resources. These scores depend on specific characteristics of the water body such as suspended solids, mean depth, public ownership, ecological significance, and many more. In the case of suspended solids, Illinois assigns a lake 15 points if total suspended solids is above 25 mg/l, and 0 points if the concentration is below 5 mg/l. Similar scores are assigned for other characteristics and the scores are then summed to determine the top priority water bodies (a higher score usually means a higher priority).

In contrast to Illinois, New Mexico uses a decision tree approach to rank its water bodies (see Figure 1, page 28). Instead of numerical scores, New Mexico ranks its water bodies based on a series of questions. These questions include: 1) are there frequent standards violations; 2) is the resource of high value; and 3) are there tools and resources available to address the problem. If it is possible to answer "yes" to each of these questions the water body is ranked at top priority for protection or restoration efforts. After all questions are answered, a numerical rank is assigned depending on the number of questions answered with a "yes."

Most states periodically revise their list of priority water bodies. In New York, this review process occurs annually at each of their regional offices and includes the Regional Water Engineer, the Regional Fisheries Manager, and the Director of the Monitoring and Assessment Bureau. The regional representatives provide knowledge and information on local conditions, while the Bureau Director assures statewide uniformity in the process. In other states, the review process is less formal.

The possibility exists to use a computer program to calculate the prioritization systems discussed here, however New York is the only state that has done so. New York uses dBase III to calculate its priority ranking. Most of the other states are in the process of, or will be, placing their prioritization system on a computer program such as LOTUS 1-2-3 or Quattro. New Mexico intends to expand their ranking system to include the evaluation of toxic water bodies, at which time they will begin using the computer program ENABLE to compute their NPS waterbody prioritization.

Priority Ranking Criteria

Almost all systems consider the following four criteria when deciding whether to obligate limited resources for water quality restoration or protection efforts:

1) severity or threat of impairment;
2) public value of the water body;
3) resolvability of NPS impairment; and,
4) availability and quality of assessment information.

This section reviews these characteristics and discusses the types and sources of information used to prioritize water bodies.

Severity or Threat of Impairment

Severity of water quality impairment from NPS pollution is usually expressed in terms of its effect on beneficial uses. Impairment may be measured as a change in use support, degradation of the aquatic or riparian environment, extent of stream impaired, and/or change in instream chemical parameters. Beneficial uses include drinking, contact and noncontact water-based recreation, propagation of aquatic species, irrigation, livestock watering, and industrial processing. In some states, such as New York, priorities are assigned in part on the basis of the waterbody's use classification. States usually give highest priority to those water bodies designated for drinking water, cold water fisheries, or swimming.

Chemical water quality criteria or standards are frequently difficult to apply to NPS pollutants or impacts because they are not sensitive to the low frequency/high intensity storm events, which drive NPS pollution (acid mine drainage is an exception). Even though NPS violations of chemical water quality criteria or standards are seldom observed, NPS pollutant flux can be substantial. Short duration high concentrations of toxic materials may impair fisheries or disturb aquatic communities. High fluxes of pollutants (nutrients or pesticides) may also build up in sediments or degrade the trophic state of lakes.

As a result, most states evaluate NPS impairments with biological indicators where possible. The advantage of biological indicators is that they integrate the impacts of various pollutants over time and they reflect the ecological health of the water body. Their disadvantage is that they are not sensitive to sources of pollutants and may be difficult to quantify for management objectives.

Biological monitoring is gaining increased recognition for its ease of use and cost-savings in NPS water quality monitoring (U.S. EPA, 1987c). Indices are available to assess riparian and aquatic habitat, stream macroinvertebrate communities, fisheries, and lake trophic state (Coffey, 1988). Generally there are no standards for these indices, but EPA and select states have been developing an ecoregion concept as a basis for regional standards for different biological indicators (Omernik, 1987). These *biocriteria* should be more useful than instream chemical standards because they will reflect the attainable characteristics of species in an ecoregion, but as noted earlier they are not sensitive to sources of pollutants.

Public Value of the Water Bodies

States use a variety of methods to assess the potential value of impaired water bodies. These indicators include amount of recreational activity, size of the water body, uses (drinking, body contact), and amount and quality of wildlife species and habitat. Frequently it is difficult and expensive to measure these indicators. Therefore, states

also use related indicators such as proximity to population centers, public access, and uniqueness of the water body. Some states use their use classifications, e.g., drinking, swimming, fishing, assigned to a water body to quantify potential resource value. None of the state ranking processes that we reviewed assigned a monetary value to their water bodies.

The value of an impaired water body is also evaluated by some states in terms of the public and political support for clean-up. Public support is important because it helps insure access to the long-term funding necessary for most NPS projects. In addition, it signals the willingness of area residents to make changes in their land use/management activities that contribute to NPS pollution.

Resolvability of NPS Impairment

Resolvability refers to: 1) whether the critical NPS pollutants can be controlled with the available management tools, and 2) whether the impaired water body will recover in a timely fashion following control of pollutants (U.S. EPA, 1987b). States generally score projects higher if appropriate management tools are available and the water body is likely to respond to control efforts.

Availability and Quality of Assessment Information

Information to establish priority for a NPS-impaired water body is frequently limited or not available. To help solve this problem, New Mexico uses a method to prioritize data collection efforts for these water bodies. Under the New Mexico system, water bodies with greater resource value and impending threats are given greater priority for water quality data collection and analysis. Most state ranking processes we reviewed did not evaluate water bodies to establish priority for the collection and analysis of additional data. Where appropriate, states can adapt the New Mexico process to fit their information needs.

Role of Priority Ranking in NPS Programs

Priority Ranking and EPA NPS Program

Under section 319 of the 1987 Clean Water Act (CWA), EPA has issued NPS guidance that explains the role of priority ranking in state NPS Management Programs (U.S. EPA, 1987d). This guidance recommends that states select their highest priority NPS problem areas for the development and implementation of NPS Management Programs. According to the guidance:

> The guiding principles in evaluating a State's waters are to maximize environmental benefits by devoting resources and efforts to water resources in a **priority order** that recognizes the values of the waterbody in question, the benefits to be realized from various control actions (including evidence of local public interest and support), and the controllability of the problem(s) (emphasis added).

Water bodies are ranked to decide which NPS impaired or threatened water body should be treated first. The ranking process is based on a set of parameters that are indicators of the degree and type of water quality problem, the difficulty involved in restoration and/or preservation, and the type and approximate value of expected benefits of restoration. Each state uses its own ranking process.

In NPS pollution management, ranking water bodies is one part of a larger priority setting process known as *targeting*. EPA's Office of Water has made targeting an integral component of its NPS policy and has issued a technical publication titled *Setting Priorities: The Key to NPS Control* (U.S. EPA, 1987b). This publication explains how to develop a targeted NPS program and set priorities at the state and watershed levels (the manual's suggestions for setting priorities at the state level are briefly reviewed in the next chapter).

The State Clean Water Strategy

Ranking priority water bodies is also a key part of EPA's State Clean Water Strategy (SCWS). EPA developed the SCWS as a way to coordinate state data collection and program management efforts required by the Water Quality Act of 1987. The SCWS encompasses the following sections of the WQA: 1) Management of Nonpoint Sources of Pollution (section 319), 2) Individual Control Strategies for Toxic Pollutants (section 304), 3) Clean Lakes (section 314), and 4) The National Estuary Program (section 320).

States choosing to implement their section 319 program under the SCWS are requested to: 1) assess threatened or impaired water bodies, 2) target priority water bodies, and 3) develop management programs to address water quality problems.

Step two of the SCWS, targeting priority water bodies, should, according to EPA, result *in the targeting of water bodies that reflects an evaluation of relative value and benefit* (U.S. EPA, 1987e). The SCWS criteria for targeting pri rity water bodies are summarized in Box 1.

Box 1
Targeting Criteria for the State Clean Water Strategy

1. What water bodies are currently or potentially most valuable from various perspectives--aquatic habitat, recreation and water supply for example?
2. What water bodies are subject to adverse effects from both pollution and aquatic habitat destruction (wetlands)?
3. What tools are available to address the identified problems?
4. What areas are most likely to be improved through governmental action?
5. Which problems are most amenable to the available tools and controls?
6. What is the degree of public support (local or statewide) to protect a particular aquatic resource?
7. How willing are other governmental agencies to take steps to use their tools and resources to help address the problem?
8. Where would "combined actions" offer the greatest benefit relative to the value of the aquatic resource?

Priority Criteria for Section 319(h) Grants

EPA has established a set of priority criteria for awarding section 319(h) grants. NPS projects that meet these criteria, which are listed in Box 2, will be given preference in the award of section 319(h) grant funds. Regional EPA offices may add additional criteria. The criteria that emphasize ranking priority water bodies are highlighted (U.S. EPA, 1987d).

Box 2
Priority Grant Criteria for Section 319 Funds

1. **control particularly difficult or serious nonpoint source pollution problems, including but not limited to, problems resulting from mining activities;**
2. implement innovative methods or practices for controlling nonpoint sources of pollution, including regulatory (e.g. enforcement) programs where the Administrator deems appropriate;
3. control interstate nonpoint source problems;
4. carry out ground-water quality protection activities which the Administrator determines are part of a comprehensive nonpoint source pollution control program;
5. **address nationally significant, high risk NPS problems;**
6. address surface/ground-water (cross-media) issues;
7. integrate Federal, state, and local programs;
8. provide for monitoring/evaluation of program effectiveness;
9. comprehensively integrate CWA requirements;
10. demonstrate a long-term commitment to building of institutions necessary for effective NPS management and the continuation of such institutions beyond the authorization period; or
11. EPA Regions may have additional criteria or priorities for delegating funds.

(Emphasis added)

Identification of Water Bodies Lacking Reliable Data

The assessment of all NPS impaired or threatened water bodies can place a large burden on state resources. As a result, EPA's NPS guidance and SCWS encourages states to develop a strategy for the collection of additional data. According to EPA's NPS guidance:

> The State should clearly identify navigable waters where available information does not support reliable assessment, **and provide a strategy and timetable for completing the assessment of these navigable waters** in either their Assessment Report or Management Program (emphasis added).

This strategy should focus data collection and evaluation efforts on water bodies where NPS management is expected to produced the greatest public benefits. Some of the ranking processes discussed in this report can help states identify high priority water bodies for which they lack the necessary information to fulfill section 319 assessment requirements.

Public Notice and Opportunity for Public Comment

EPA strongly encourages states to involve other groups with water quality interests in the development of State Management Programs and the selection of NPS priority water bodies. The involvement of local groups can be particularly valuable where the lack of reliable data precludes the identification of priority water bodies. Most of the case studies reported here provide opportunity for public input.

Setting State Level Priorities

In developing a process to rank impaired water bodies for NPS control actions, states should consider a number of additional factors necessary to achieve an optimal distribution of efforts and funds including, 1)concerns and interests of participating agencies, and 2) resources and capabilities of participating institutions. In the following discussion we review these general guidelines on setting priorities at the state level from the *Setting Priorities* manual (U.S. EPA, 1987b).

Concerns and Interests of Participating Agencies

Addressing NPS impairments usually requires close cooperation among a variety of agencies including water quality, natural resource, land use planning, agriculture, and health. Coordination among these different agencies is essential so as to minimize duplication of effort and inter-agency conflict.

Each agency will have authority to perform certain types of tasks, such as technical assistance, monitoring, and enforcement. These responsibilities are likely to help set each agency's priorities for controlling NPS pollution, e.g. agricultur pollution is USDA's primary water quality concern. USDA will contribute to the effort for continuity in on by utilizing the 319 Assessment to set USDA watershed priorities in the 1990 Initiative. Where possibl the state agency responsible for section 319 should make sure that the NPS ranking procedure also reflects the priorities of the cooperating agencies, including USDA.

Assess Institutional Resources and Capabilities

One of the key reasons for ranking NPS impaired water bodies is to focus efforts on as many water bodies as can be effectively treated with existing resources. This helps insure observable water quality improvements, which is important for maintaining public and legislative enthusiasm.

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ILLINOIS LAKE PRIORITY SYSTEM

Introduction

The state of Illinois has established a four tier targeting process for selection of rural NPS abatement projects. This process allows federal, state, and local agencies to participate in the planning, implementation, and evaluation of rural NPS projects. The Illinois lake classification system information is utilized as input in this process.

The Illinois lake classification system is used to screen and evaluate lakes for funding under the U.S. EPA Clean Lakes Program (CLP). Many of the CLP's priorities parallel section 319 priorities. As a result, the Illinois priority ranking mechanism can help states select NPS impaired or threatened water bodies for their NPS Management Program. The Illinois State Watershed Priorities Committee uses the program to prioritize watershed land treatment projects for funding. Since this mechanism is designed primarily to screen lakes, application to streams will require some modification.

Illinois EPA's Division of Water Pollution Control (DWPC) assesses lakes for the following evaluation categories: 1) current water quality; 2) potential water quality or improvement/maintenance potential; and 3) public benefits. Within each category, lakes are evaluated based on measurements and indicators of water quality, hydrology, watershed characteristics, and lake use. Lakes with greater priority for rehabilitation or management receive a higher score. Possible scores for each category are shown in Table 1.

Table 1
Lake Evaluation Categories and Possible Scores

Evaluation Category	Possible Points
Current Water Quality	40 - 100
Potential Water Quality	0 - 100
Public Benefits	0 - 150

Current Water Quality Evaluation

Current water quality is evaluated according to the following factors: 1) Carlson's Trophic State Index; 2) severity of use impairment from sediment; and 3) severity of use impairment from aquatic macrophytes. Possible scores for current water quality range from 40 to 100 points (the higher score means greater impairment and greater priority for clean-up efforts). Scores for each water quality factor are shown in Table 2.

Trophic State Index

Carlson's Trophic State Index (TSI) gauges lake eutrophic conditions and provides a uniform measure for comparing lakes. The TSI is commonly used by state agencies and provides a uniform basis for comparing

eutrophic conditions across states and regions. The TSI is reviewed in Box 3, "Measuring Carlson's Trophic State Index."

TSI scores for each lake are translated into DWPC scores according to the weighting criteria in Table 2, part 1 (Mean Tropic State Index). In developing the weighting criteria, the DWPC decided that moderately eutrophic and hypereutrophic lakes should receive the same priority. In other words, hypereutrophic lakes are considered as polluted as moderately eutrophic lakes. Therefore, any lake with a TSI score above 70 was not given greater priority in the DWPC scoring system. Mesotrophic or oligotrophic lakes, which scored 50 or less on the trophic state index, received the minimum score for this factor (40 DWPC points).

Box 3
Measuring Carlson's Trophic State Index

TSI can be calculated from Secchi disc transparency in meters, chlorophyll a in ug/l, and total phosphorus in ug/l. The following equations are used to calculate the index number.

Secchi Disc	$TSI_{SD} = 60 - 14.41 \ln SD$
Chlorophyl a	$TSI_{CHLA} = 9.81 \ln CHLA + 30.6$
Total Phosphorus	$TSI_{TP} = 14.42 \ln TP + 4.15$

TSI for Illinois lakes is calculated from the mean of TSI_{SD}, TSI_{CHLA} and TSI_{TP}. Where only one or two of these parameters is available, TSI is based on the mean of the available parameters. LANDSAT multispectral data can also be used to estimate TSI (Sefton and Little, 1983). In Illinois, where instream sampling data are not available LANDSAT data are used.

When interpreting TSI calculations, DWPC explains that it is important to consider a number of Carlson's assumptions.

1. Secchi transparency is a function of phytoplankton biomass;
2. phosphorus is the factor limiting algal growth; and,
3. total phosphorus concentration is directly correlated with algal biomass.

In the case of Illinois and other lakes, these assumptions may not be valid where:

1. suspended solids other than algal biomass are a major source of turbidity;
2. short retention times or inorganic turbidity prohibits a large algal standing crop from developing even though large amounts of phosphorus may be present;
3. grazing by zooplankton is affecting algal populations; or,
4. the phosphorus is used primarily in the production of macrophytes rather than algae.

For Illinois lakes, the Carlson TSI value also reflects sediment-related turbidity; therefore, the higher the TSI value, the greater impairment the lake likely exhibits from sediment-related turbidity or algal blooms. Thus, even if the Carlson assumptions do not hold true for Illinois lakes, the TSI still provides a reasonable, uniform means of rating Illinois lakes according to eutrophic condition and use impairment.

Table 2
Current Water Quality Evaluation
(Possible score: 40 - 100 points)

Evaluation Factor	Weighting Criteria	Points
1. Mean Tropic State Index (Carlson, 1977)	a. ≥70	70
	b. ≥60 <70	60
	c. ≥50 <60	50
	d. <50	40
2. Use Impairment from Sediment	a. Substantial[1]	15
	b. Moderate	10
	c. Slight	5
	d. Minimal	0
3. Use Impairment from Aquatic Macrophytes	a. Substantial	15
	b. Moderate	10
	c. Slight	5
	d. Minimal	0

[1] See text for discussion of weighting criteria.

Use Impairment from Sediment

Illinois Environmental Protection Agency's initial water quality management planning efforts documented the most severe agricultural NPS related problem in Illinois, which was soil erosion resulting in lake sedimentation. Suspended or deposited sediment is a major cause of use impairment in Illinois lakes. Based on field observations and examination of sampling data, qualitative sediment impairment ratings have been developed by Illinois EPA staff and Department of Conservation field biologists, and are shown in Table 3. The criteria used to evaluate use impairment from sediment are total suspended solids, secchi disc transparency, and annual loss in lake capacity. The mean score of these criteria, from Table 3, is used to calculate the DWPC sediment score in Table 2. Those lakes showing substantial impairment receive 15 points, while minimally impaired lakes receive 0 points.

Table 3
Use Impairment from Sediment[1]

Criteria	Weight		Points
1. Total Suspended Solids (mg/l)	a. Substantial	>25	15
	b. Moderate	>15 ≤25	10
	c. Slight	>5 ≤15	5
	d. Minimal	≤5	0
2. Secchi Disc Transparency (in.)	a. Substantial	<24	15
	b. Moderate	≥24 <48	10
	c. Slight	≥48 <79	5
	d. Minimal	≥79	0
3. Annual Loss in Capacity (%)	a. Substantial	>0.75	15
	b. Moderate	>0.50 ≤0.75	10
	c. Slight	>0.25 ≤0.50	5
	d. Minimal	≤0.25	0

[1] This table is summarized in Table 2.

Use Impairment from Aquatic Macrophytes

Lakes are also evaluated for use impairment from aquatic macrophytes (aquatic plants) according to the criteria in Table 4. Impairment is based on the percent of littoral area (shoreline) covered by macrophytes. Scores range from 15 points for lakes with substantial macrophyte impairment (75% coverage or more), to 0 points for minimally impaired lakes (less than 25% coverage).

Table 4
Use Impairment from Aquatic Macrophytes

Criteria	Weight		Points
Littoral Area Covered by Macrophytes (%)	a. Substantial	>75	15
	b. Moderate	>50 ≤75	10
	c. Slight	>25 ≤50	5
	d. Minimal	≤25	0

[1]This table is summarized in Table 2.

DWPC evaluates aquatic macrophyte impairment, in addition to TSI, because even though a lake is clear, and has a low chlorophyll a level and TSI score, aquatic macrophytes may severely impair use. Carlson's assumption that all phosphorus in the water column results in algal biomass limits the usefulness of the TSI for evaluating aquatic macrophytes.

Potential Water Quality Evaluation

DWPC uses four factors to rate each lake's potential water quality or improvement/maintenance potential: 1) ratio of watershed area to lake surface area; 2) mean depth; 3) water retention time; and, 4) lake size. These factors help to indicate the difficulty in achieving and maintaining water quality improvements. DWPC wanted to avoid projects where costly structural measures would have been required to change lake morphology or hydrology. Possible scores for each factor are presented in Table 5. Total score for these set of factors ranges from 0 to 100 points.

Watershed Area/Lake Surface Area Ratio

The ratio of watershed area to lake surface area can help describe the relative importance of NPS pollutant loadings. As the size of the watershed increases relative to the lake size, the likelihood that nonpoint sources of pollution provide a significant portion of the lake's nutrient and sediment load increases. In these watersheds, even cropland that delivers a very low amount of sediment, nutrients or pesticides on a per acre basis can have a significant effect where these loadings are channeled into a small water body.

Studies of Illinois lakes showed that the highest quality lakes had watershed/surface area ratios of less than 20 to 1, while poorest quality lakes had ratios greater than 100 to 1 (Boland et al., 1979; Sefton, 1978; and, Sefton et al., 1980). As the ratio increases, problems due to siltation, turbidity and nutrients are more likely to increase. Furthermore, U.S. EPA's Clean Lakes Program Guidance (U.S. EPA, 1980a) reports that it may not be possible to control nutrients and sediment sufficiently where the watershed/surface ratio exceeds 20 to 1. According to Peterson (1981), above this ratio "significant nutrient reductions from the watershed may be impractical."

In evaluating a lake's water quality improvement potential, DWPC scores ranged from a maximum of 30 points, where the watershed/surface area ratio was less than 20 to 1, to 0 points where this ratio exceeded 100 to 1 (see Table 5).

Table 5
Potential Water Quality Evaluation Factors and Scores
(Possible Score: 0 to 100 points)

	Evaluation Factor	Weighting Criteria	Points
1.	Ratio of Watershed Area to Lake Surface Area	a. ≤20:1	30
		b. >20:1 ≤50:1	20
		c. >50:1 ≤100:1	10
		d. >100:1	0
2.	Mean Depth (feet)	a. >15	30
		b. >10 ≤15	20
		c. > 5 ≤10	10
		d. ≤5	0
3.	Retention Time (years)	a. >1.0	30
		b. >0.50 ≤1.0	20
		c. >0.25 ≤0.50	10
		d. ≤0.25	0
4.	Lake Size (acres)	a. >100 ≤500	10
		b. > 40 ≤100 or >500 ≤1000	5
		d. ≤40 or >1000	0

Mean Depth

Lake water quality and improvement potential generally increases with deep lakes. Deeper lakes store more oxygen, which in Illinois helps prevent winter fish kills. Shallow lakes more frequently suffer from resuspension of nutrients and sediment due to wind and lake traffic, and less stable stratification. Use impairment from aquatic macrophytes is also more likely to occur in shallow lakes.

Deeper lakes receive a higher priority under the DWPC scoring system (see Table 5). DWPC determined that lakes with a mean depth of 15 feet or greater were more likely to show improvement from rehabilitation efforts. These lakes received the maximum score of 30 points. Shallow lakes were given less priority because they were more likely to require costly structural measures such as dredging.

Water Retention Time

A number of studies have shown that Illinois lakes with water retention time of one year or more have better water quality (Sefton, 1978; Boland et al., 1979; Sefton and Meyer, 1980). Retention time is calculated as lake volume divided by volume of watershed runoff per year. Lakes with shorter water retention time receive relatively greater volumes of watershed runoff. Greater runoff carries larger amounts of nutrients, which can stimulate algal and weed growth, and sediment, which can reduce lake capacity (Bachmann, 1983). Shorter water retention time will not create a problem where incoming water is of good quality or the water has a very short summer retention time, which prevents build-up of algal blooms (Dillon, 1975).

Illinois lakes with a longer water retention time receive higher priority under the DWPC scoring system. The maximum score was 30 points for lakes with retention times longer than one year. If the retention time was less than 0.25 years, the lake received 0 points.

Lake Size

As lake size increases, the control of nutrients and sediments becomes more difficult requiring a greater investment of resources. From the sport fisheries management perspective, lakes between 100 and 500 acres are the best candidates for implementation of a management strategy (Paladino, 1983). These lakes received 10 points, the highest score for this category (see Table 5). Lakes smaller than 40 acres received 0 points because they are generally not capable of supporting a diverse sport fishery.

Public Benefits Evaluation

To identify the lakes most important to the public, DWPC conducts a public benefit evaluation of Illinois' lakes. Those lakes with the greatest current or potential public benefit are deemed candidates for the expenditure of public funds for protection or rehabilitation. The seven factors utilized in the public benefits evaluation are listed in Table 6, along with the weighting criteria and possible scores. Higher scores reflect greater public benefits. For each lake, the potential benefit score ranges from 0 to 150 points.

Public Ownership/Access

DWPC considers public ownership and the availability of public access two of the most important factors in evaluating a lakes' public benefits. Four levels of public ownership/access are used to evaluate benefits (see Table 6).

1) The entire lake bottom is publicly owned and the entire shoreline is accessible to the public; or, the lake is dedicated to public use and the entire shoreline is accessible to the public.

2) The entire lake bottom is publicly owned but the shoreline is not entirely accessible to the public; or, the lake is dedicated to public use and most of the shoreline is accessible to the public.

3) The lake is partially owned by the public and there is partial public access to the shoreline; or, a limited portion of the lake is dedicated to public use and access.

4) The lake is either not publicly owned and not dedicated to public use or there is no public access.

Amount of Recreational Use

The magnitude of public benefits increases as the number of recreationists increase (U.S. EPA, 1980b). Estimates of usage frequency were obtained from lake managers, Illinois Department of Conservation staff, or Illinois EPA field staff. Lakes with very heavy use (>200,000 visitors/year) receive the maximum score of 15 points, while lakes with light use (<25,000 visitors/year) receive 0 points, as shown in Table 6.

Proximity to a Standard Metropolitan Statistical Area (SMSA)

In general, SMSAs are large metropolitan areas and their adjacent communities with a population greater than 50,000. The location of SMSAs is available from U.S. Bureau of Census.

An EPA study shows that protecting or restoring lakes near or in urban areas produces greater recreational and other types of benefits than projects conducted far from SMSAs. Proximity and easy access to a lake is a major factor in the number of users and amount of benefits (U.S. EPA, 1980b). Scores for this factor are shown in Table 6.

Availability of Other Publicly Owned Lakes

In prioritizing lakes, the Illinois Department of Conservation considers the supply of lakes in the area versus the existing or potential demand. Greater priority is given to areas where high quality lakes are scarce and user demands are large. Availability of other publicly owned lakes is measured as the acres of publicly owned lakes in a county divided by the county population. Where availability is low, lakes are assigned a higher score, as shown in Table 6.

Public Water Supply Usage

Lakes that serve as a primary or alternative public water supply were considered to provide additional public benefits. Primary water supplies received 20 points, while alternative water supplies received 10 points (see Table 6).

Recreational Facilities

The existence of recreational facilities helps increase the public benefits associated with a lake. Recreational facilities considered in this evaluation are: beach, boat ramp, picnic area, camping area, park, boat rental, concession, marina, and bicycle trail. Lakes with more facilities received a higher score, as shown in Table 6.

Environmental Uniqueness

Lakes that represent a unique or uncommon natural resource, and that provide a unique or uncommon natural setting have "immeasurable public benefit," according to DWPC. Unique or "unmatched" lake resources receive an additional 50 points. The criteria for identifying these lakes are: 1) oligotrophic water quality; 2) capability to support year-round cold water fisheries; 3) capability to support rare or endangered species highly valued by Illinois residents; and, 4) provide a unique one-of-a-kind environmental setting for Illinois.

Uncommon lake resources receive 25 additional points. The criteria for identifying these lakes is less rigid and includes: 1) mesotrophic water quality; 2) capability to support a put-and-take trout fishery; 3) natural glacial lakes with undeveloped shorelines and natural surroundings or which are part of a chain-of-lakes; 4) artificial lakes in urban areas which have unusual, natural, undeveloped surroundings; and, 5) artificial lakes in rural area which are deep with steep watershed terrains and rock outcroppings in addition to natural, undeveloped surroundings. These scores are also shown in Table 6.

Overall Lake Classification Rating

The overall classification rating for each lake is obtained by summing the points received in the three evaluation categories. The higher the total rating on a scale of 40-350, the better candidate the lake for Clean Lakes funding or implementation of protection, restoration, or management measures. The classification list serves as an initial screening tool for determining those projects which are best candidates for implementation of protection, restoration, or management measures. It does not restrict the order that projects may be submitted for assistance or funded. Factors such as local priorities, local interest, resource commitment, and readiness to proceed are also evaluated in conjunction with this rating when developing the final priority ranking of applications for various program authorities each year.

Table 6
Public Benefits Evaluation Factors and Scores

Evaluation Factor	Weighting Criteria[1]	Points
1. Public Ownership/Access	a. Entire lake bottom publicly owned and entire shoreline public access; or, dedicated to public use and entire shoreline public access.	30
	b. Entire lake bottom publicly owned but entire shoreline not public access; or, dedicated to public use and most of shoreline public access.	20
	c. Partially publicly owned and partially public assess; or, a limited portion dedicated to public use and public access.	10
	d. Either not publicly owned and not dedicated to public use; or, no public access.	0
2. Amount of recreational use associated with lake	a. Very heavy (>200,000 visitors per year)	15
	b. Heavy (>100,000 ≤200,000 visitors per year)	10
	c. Moderate (> 25,000 ≤100,000 visitors per year)	5
	d. Light (≤ 25,000 visitors per year)	0
3. Proximity to Standard Metropolitan Statistical Area (SMSA)	a. Within SMSA (0 miles)	15
	b. > 0 ≤25 miles	10
	c. >25 ≤50 miles	5
	d. >50 miles	0
4. Availability of other publicly owned lakes (expressed as Public Lake Surface Area/County Population)	a. <0.01 acres per capita	10
	b. >0.01 ≤0.1 acres per capita	5
	c. >0.1 acres per capita	0
5. Public water supply usage	a. Primary public water supply	20
	b. Alternate public water supply	10
	c. Not a public water supply	0
6. Recreational facilities	a. Facilities to support four or more recreational uses, or facilities for swimming.	10
	b. Facilities to support two or three recreational uses.	5
	c. Facilities to support only one recreational use.	0
7. Environmental uniqueness	a. Unique (unmatched) natural or aquatic resource and environmental setting for Illinois.	50
	b. Uncommon natural or aquatic resource and environmental setting for Illinois.	25
	c. Not a unique or uncommon natural or aquatic resource or environmental setting for Illinois.	0

[1] See text for discussion of weighting criteria.

Reference

Sefton, D.F. and J.R. Little. *Classification/Needs Assessment of Illinois Lakes for Protection, Restoration and Management.* Illinois Environmental Protection Agency, Division of Water Pollution Control, Planning Section. Springfield: February 1984.

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OHIO WATERBODY PRIORITY SYSTEM

Introduction

In response to the Clean Lakes Program, Ohio Environmental Protection Agency developed a ranking process to prioritize their lakes for restoration and protection. Ohio's ranking process is divided into four parts to consider separately: 1) public benefits, 2) water quality and ecological value, 3) lake morphology and watershed characteristics, and 4) local funding criteria.

Public Benefits

Proximity of Lake to Major Population Center

Under this criteria, lakes located closer to major population centers are given greater priority (see Table 7). Cities with a population greater than 20,000 are considered a major population center. Proximity to major population centers is considered less biased than actual lake attendance estimates because it accounts for potential utilization. Where several smaller cities are located near a lake, their populations are summed.

Table 7
Proximity to Major Population Center*

Weighting Criteria	Score
≤5 miles	10 points
>5 ≤10 miles	5 points
>10 ≤25 miles	2 points
>25 miles	0 points

*Major population center is defined as city with a population greater than 20,000.

Proximity to Other Public Recreational Lakes

A lake is given greater priority when alternative recreational lakes are not available to the public (see Table 8). The purpose of this criteria is to increase lake recreational opportunities where they do not currently exist.

Table 8
Proximity to Other Public Recreational Lakes

Weighting Criteria	Score
≤10 miles	0 points
>10 ≤20 miles	3 points
>20 ≤40 miles	5 points
>40 miles	10 points

Public Ownership of Shoreline

Public ownership of lake shoreline is use[illegible] a surrogate measure of the potential public benefits derived from a lake restoration or protection project[illegible] Table 9). According to Ohio EPA, it has been their experience that when private ownership of the shor[illegible]is high, public access is frequently restricted.

Table 9
Public Ownership of Shoreline

Weighting Criteria*	Score
≤10 percent	2 points
>10 ≤30 percent	4 points
>30 ≤70 percent	7 points
>70 percent	10 points

*Percent of lake publicly owned.

Existing and/or Potential Uses and Recreational Opportunities

A lake is aw[illegible]ded five points for each available use or recreational activity listed in Table 10. Points are also "awarded liberally for potential recreational opportunities." Lakes may only meet the criteria for "Public access clearly marked" where public access is currently marked. Currently used public drinking water reservoirs are always awarded points. Potential water supply reservoirs must be of significant volume and in close proximity to a user population.

Table 10
Existing and/or Potential Uses and Recreational Opportunities*

Activity	Score
Fishing opportunity	5 points
Boating opportunity	5 points
Swimming opportunity	5 points
Public ac[illegible]s clearly marked	5 points
Lake wit[illegible]4 mile of public transportation	5 points
Lake is c[illegible]be used as a public water supply	5 points

*A lake may receive a total of 30[illegible]s for this criteria.

Water Quality and Ecological Value

Trophic State

Lakes that score lower on Carlson's Trophic State Index (TSI)--are less eutrophic--are given greater priority for protection or restoration (Carlson, 1977). Ohio EPA believes that the enhancement or protection of less eutrophic lakes is more cost-effective.

The TSI is based on summer chlorophyll a, summer secchi disk transparency, and total phosphorus. For a more complete discussion of TSI calculations see Box 3 in the Illinois case study.

Table 11
Trophic Level Classification

Weighting Criteria	TSI*	Score
Hypereutrophic	≥210	3 points
Eutrophic	≥149 <210	7 points
Mesotrophic-Oligotrophic	<149	10 points

*As defined using Carlson's Trophic State Index

Unique Ecological Characteristics

Lakes that contain unique aquatic habitats, or plant or animal species of special significance are given additional priority for protection or restoration (see Table 12).

Table 12
Unique Ecological Characteristics

Weighting Criteria	Score
Lake contains a unique ecological habitat or plants and/or animals of special significance.	15 points
Other lakes	0 points

Potential for Lake Protection or Restoration

Lake morphology and watershed characteristics play an important role in determining lake water quality and the potential for long-term water quality improvements. To evaluate the potential for lake protection or restoration, Ohio EPA assesses for each lake: 1) the ratio of drainage area to lake surface area, 2) drainage basin sediment yield, and 3) mean lake depth.

Drainage Area to Lake Surface Area

The ratio of watershed drainage area to lake surface area is one factor that determines the quantity of sediment, nutrients and other pollutants entering a lake and the difficulty involved in controlling them. In addition, lakes with high drainage area to surface area ratios may flush pollutants very quickly. As a result, Ohio EPA gives greater priority to lakes with low drainage area to surface area ratios (see Table 13).

Table 13
Watershed Drainage Area to Lake Surface Area Ratio

Weighting Criteria	Score
≥200 to 1	0 points
≥100 <200 to 1	2 points
≥50 <100 to 1	4 points
≥20 <50 to 1	6 points
≥5 <20 to 1	8 points
<5 to 1	10 points

Drainage Basin Sediment Yield

Restoration and protection efforts in lakes located in basins with lower sediment yields are more likely to produce longer term benefits. Ohio EPA gives these lakes greater priority (see Table 14). Sediment yield estimates for each lake were based on the publication *Sediment in Ohio* (Anttila and Tobin, 1978).

Mean Lake Depth

Based on work by Vollenweider and Dillon (1974), shallow lakes are more likely to become eutrophic than deep lakes receiving the same nutrient loadings. Therefore, Ohio EPA gives greater preference to deep lakes because they can be more easily protected from eutrophication (see Table 15).

Table 14
Drainage Basin Sediment Yield

Weighting Criteria*	Score
Low	10 points
Moderately low	7 points
Moderate	5 points
Moderately high	2 points
High	0 points

*Based on sediment yield map in Anttila and Tobin, 1978.

Table 15
Mean Lake Depth

Weighting Criteria	Score
≤2 meters	0 points
>2 ≤5 meters	2 points
>5 ≤10 meters	5 points
≥10 meters	10 points

Local Funding Criteria

After numerical scores have been determined, potential lake projects are reviewed to evaluate the availability of local matching funds, and placed in one of the three groups listed in Table 16. Within each of these categories, projects are ranked according to their numerical scores. The purpose of these funding groups is to increase the priority of lakes with low numerical scores but strong local monetary support. Only lakes in group A receive state support. If local funds do become available, projects in group B or C can be moved to group A.

Table 16
Local Funding Criteria

Criteria	Group
In this group are those lakes for which local matching funds are available or might be available in the near future, and for which Phase I* and Phase II* applications are believed to be forthcoming.	A
In this group are those lakes where there is a viable interest in applying for Phase I or Phase II funding, but where local matching funds are unavailable.	B
In this group are those lakes recommended for inclusion on the prioritization list but for which active local support has not been identified.	C

*Phase I applications are for feasibility studies and Phase II are for funds for restoration.

Reference

Ohio EPA. *Report on Ohio's Priority Lakes for Restoration or Protection,* by John D. Youger. Division of Surveillance and Standards. Columbus: January 1982.

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NEW YORK WATERBODY PRIORITY SYSTEM

Introduction

New York issues a "Priority Problem Water List" to help guide the expenditure of water program resources and document workload for federal grants and loans. This list covers approximately 3,500 miles of rivers and their associated lakes, 1,500 square miles of estuaries and bays, and the Great Lakes bordering New York.

Stream segments, which includes lakes, where designated uses are impaired from either point or nonpoint sources of pollution are included on the list. Each stream segment is evaluated according to its type, degree and aerial extent of impairment. Critical pollutants and their sources are also considered, along with waterbody value, stream flow and state water quality classification. Omitted from this assessment are legal mandates, feasibility, and remediation or protection costs.

The priority list is revised biannually by a panel convened at each of the nine Department of Conservation (DEC) Regional Offices. Participants in the panel include the Regional Water Engineer, the Regional Fisheries Manager, and the Director of the Monitoring and Assessment Bureau. The regional representatives provide knowledge of research studies, monitoring data, and public perception of use impairment in their area, while the Bureau Director assures statewide uniformity in the process.

In 1988, DEC initiated a program to elicit greater public input from New York citizens who fish, swim, sail, or live at the edge of state waters. Many of these people have intimate knowledge about the use of the state's water bodies. The state will distribute this public input to each of the nine Regional Offices. Public complaints and concerns can be used to modify the list of priority water bodies.

The Scoring System

Only stream segments that have demonstrated water quality impairment are placed on the priority list. Stream segments are prioritized according to: 1) water classification, which is based on the best possible use for that segment (types of use considered include drinking water, swimming, and fishing); 2) severity of the problem, which is based on the frequency of use impairment; 3) flow; and, 4) potential resource value, which for freshwater is based on the segment's public access, uniqueness, and size. Potential resource value for marine waters is based on shellfish productivity and presence of migratory passageway for anadromous fish.

A priority score is computed for each impaired stream segment according to the following equation:

$$\text{Priority Score} = P_1W_1 + P_2W_2 + P_3W_3 + P_4$$

where

P_1 = Stream Classification Factor = 35 points
P_2 = Problem Severity Factor = 30 points
P_3 = Flow Factor = 10 points
P_4 = Potential Resource Value = 0 to 25 points

Maximum Score = 100 points

and

W_1 = Stream Classification Weighing Factor
W_2 = Problem Severity Weighing Factor
W_3 = Flow Weighing Factor

Scores for stream classification (P_1W_1), problem severity (P_2W_2), and flow (P_3W_3) will vary according to the weighing factors ($W_{1...3}$), which are expressed in fractional values (0.1 to 1.0). Unlike $P_1...P_3$, P_4 is expressed as the sum of its potential resource value factors. The maximum score a stream segment may receive is 100 points. Based on their score, impaired stream segments are then given a high, medium, or low priority, as shown in Table 17.

Table 17
Priority Ranking Classification

Rank	Score
High	80 - 100 points
Medium	60 - 79 points
Low	<60 points

Stream Classification Priority Score (P_1W_1)

The maximum score for stream classification is 35 points if the stream classification weighing factor (W_1) equals 1.0. This value is assigned to freshwater streams in their "natural" state and saline waters that support shellfishing or migratory passageways for anadromous fish (see Table 18). Classifications for less beneficial use are given a lower W_1 value. Each stream segment is assigned W_1 according to the segment's "best use" as determined by the New York State Water Classification. These classifications and W_1 value are shown in Table 18.

Problem Severity Priority Score (P_2W_2)

The maximum score for P_2W_2 is 30 points. Severity of a water quality problem is evaluated in terms of impairment of designated uses. Stream segments with more severe water quality problems receive greater priority. In the past, use impaired streams were rated as either severely, moderately, or slightly impaired, as shown in Table 19. DEC reports that the "slightly" impaired category is being removed because it is too subjective (Mack, 1988).

Two new categories are being added for DEC's ongoing assessment of NPS impaired stream segments: stressed and threatened. Stressed stream segments show intermittent or marginal use restrictions, and the natural ecosystem exhibits change in species composition, diversity, or population. These segments also receive large loads of NPS pollutants, such as cropland erosion, however, it is not possible to determine a cause and effect relationship. In the case of threatened stream segments, the water quality currently supports use and ecosystem, however, changing land use patterns may result in use impairment or ecosystem disruptions. Table 19 has not been updated to include the stressed and threatened categories because DEC has not assigned these categories numerical values.

Numerous data bases, professional observations and other information sources are considered when evaluating use impairment. Fishery managers are consulted for information on consumption advisories, anomalies, and fish

kills, in addition to ammonia and/or chlorine toxicity from wastewater treatment facilities. State and local health departments report beach closings and restrictions, and water supply restrictions. Public concerns or complaints are reviewed. Information of non-complying landfills and hazardous waste sites are also considered.

Table 18
Stream Classification Weighing Factors

Best Uses	Best Use Impairment	Weighing Factor (W_1)
Freshwater		
Natural Water[1] (This water is in its natural condition)	Point source discharge identified. Inadequate filtration by lateral soil travel identified.	1.0
Drinkable Water Primary Contact Recreation Secondary Contact Recreation (Swimming, fishing, boating)	Water declared non-potable. Failure to meet water quality standards.	0.9[2]
Primary Contact Recreation Secondary Contact Recreation (Swimming, fishing, boating)	Bathing beach closed or swimming prohibited No bathing warnings posted for 2 to 3 days following heavy rainfall	0.7[2]
Secondary Contact Recreation (Fishing and boating)	Fish not edible due to toxic concentration. Fishing prohibited/restricted. Fishkill	0.5[2]
Secondary Contact Recreation (Fishing and boating, however, aquatic habitat will not support fish propagation or balanced fish population.)	Fishing prohibited/restricted.	0.4
Saline Water		
Shellfish (Includes primary and secondary recreation)	Shellfishing lands closed.	1.0
Primary Contact Recreation Secondary Contact Recreation (Swimming, finfishing, but no shellfishing.)	Saline bathing beach closed or swimming prohibited No bathing warnings posted for 2 to 3 days following heavy rainfall	0.7
Secondary Contact Recreation (Finfishing, but no swimming or shellfishing. Includes support of viable fishing and wildlife habitat.)	Fishing prohibited/restricted. Fish species impaired/loss. Fishkill	0.5
Primarily Non-Recreational (Saline uses other than fishing and recreation.)	Fishkill	0.4

[1] Includes best uses in lower classes.
[2] Add 0.1 if stream or lake supports trout propagation or put and take trout fishing.

Table 19
Problem Severity Weighing Factors

		Weighing Factor (W_2)
Severe	A water segment is rated as having a severe problem when a designated use is precluded or not supported by the water quality of the segment. This may include beach closures or a ban on fishing.	1.0
Moderate	A water segment is given a problem severity rating of moderate when a classified use is frequently impaired. The designated uses of the segment are partially supported by the water quality of the segment, however, full use of the segment is not attained. Beaches that are closed by a moderately sized storm 25 to 50 percent of the time, or waters that have an advisory warning people not to eat the fish are considered moderately impaired.	0.6
Slight[1]	A water segment is rated as having a slight problem when a classified use is occasionally impaired. Typically, these segments have very localized problems. The designated uses of the segment are basically supported by the water quality of the segment.	0.2

[1]DEC is planning to omit this category in future assessments and to add two new categories, stressed and threatened. See text for discussion.

Flow (P_3W_3)

The flow factor gives greater priority to lakes, estuaries, and large rivers. Rivers with a MA7CD/10[1] flow greater than 150 cfs were given a weighing factor of 1.0 because they are generally of concern to the public. Streams between 20 and 150 cfs are generally of concern to fishermen and local residents, while smaller streams are noticed only by nearby residents.

Table 20
Flow Weighing Factor

Flow (MA7CD/10)[1]	Weighing Factor
Over 150 cfs, Lakes, and Estuary	1.0
150 to 20 cfs	0.7
Under 20 cfs	0.2

Potential Resource Value Priority Score (P4)

A freshwater stream's potential resource value is measured as the sum of three factors: 1) public access, 2) uniqueness, and 3) areal extent of impaired resource (see Table 21). Saline waters are measured on the basis of their shellfish productivity and the existence of migratory passageway for anadromous fish. Unlike the other three criteria, potential resource value is measured as the sum of these different factors.

The Public Access Factor is measured in terms of the percentage of the shoreline accessible to the public, as shown in Table 21. However, if a water resource has a public boat launch this constitutes greater than 50% access for segments within five miles.

[1]Minimum average 7 consecutive day/10 year flow.

The Uniqueness Factor provides four categories for evaluating stream segments. "Unique statewide fishery resource" includes very high quality trout streams and lakes with excellent walleye fishing. "Potentially unique or historically significant" includes water bodies that have been selected for the states Wild and Scenic river program. Areal Extent of Impairment Factor, like Public Access Factor, is measured coarsely and is not intended to be scientifically accurate.

Potential resource value for saline waters, as shown in Table 21, is based largely on the existence of shellfish beds and migratory passageways for anadromous fish (striped bass). According to DEC, high priority is given to these resources because of intense public interest and concern (Mack, 1988).

Resolvability

Resolvability refers to whether a water quality impairment can be corrected with the available resources, expertise, and program authority. While resolvability is not included in the priority scoring system, DEC does consider this factor in a later stage of their water quality planning process. The list of factors DEC considers is shown in Table 22.

Table 21
Ratings for Potential Resource Value

CRITERIA	POINTS (P_4)[1]
Freshwater	
Public Access Factor	
a. >50%	6
b. >10% ≤49%	4
c. <10%	2
Uniqueness Factor	
a. Unique Statewide fishery resource	12
b. Potentially unique or historically significant	10
c. Similar resources within county	8
d. Similar resources available locally	6
Areal Extent of Impairment	
a. >5 miles of streams >100 acres of lakes	7
b. >1 ≤5 miles of streams >10 ≤100 acres of lakes	5
c. <1 mile of streams <10 acres of lakes	3
Saline Waters	
a. Segment includes shellfish areas which are among the most productive in the state for any one of following: surf clam, hard clam, oyster, bay scallop, blue mussel; or,	25
Segment includes migratory passageway for anadromous fish.	25
b. Segment includes productive or potentially productive shellfish beds.	21
c. Segment supports commercial use (for food or recreation) of fishery resources.	18
d. All other segments except (e).	15
e. Segments consist of a man-made backwater and is not part of a stream or river.	10

[1] No weighting factor is used for scoring potential resource value.

Table 22
Five Classes of Resolvability

a. Manageable by Regional Office	Region has all the tools available in-house to manage the situation.
b. Requires Central Office Management	Region must look to Central Office for significant actions to manage the issue, e.g. Clean Lakes resources, facility causing impairment is located in another state.
c. Needs study and a Management Plan	Issue cannot be resolved until its solution is identified through formal study and development of management actions tailored specifically to the issue.
d. Strategy Exists, Funding Needed	An agency or person is needed to accept financial responsibility and provide the needed funds.
e. Impairment not resolvable	Technical, legal, social, and political concerns preclude impairment resolution for the foreseeable future, e.g. lead runoff from the exhaust of vehicles using leaded gasoline.
f. Condition needs verification	The condition is suspected but there is no or poor documentation, or the condition may have abated but not re-evaluated.

Reference

New York Department of Environmental Conservation. *1988 Priority Water Problem List*. Division of Water. Albany: April 1988.

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NEW MEXICO WATERBODY PRIORITY SYSTEM

Introduction

New Mexico's Environmental Improvement Division (EID) has identified and ranked priority water bodies since 1983. In 1987, a major change was made in their priority ranking system to assess NPS and point source management needs more accurately. New Mexico changed from a numerical ranking system, which was based on mathematical formulas, to a decision tree approach (see Figure 1). Prior to 1987, up to one-quarter of the total priority points were assigned on the basis of the need for point source regulatory control. The new system recognizes the need to address both the impacts of points source and NPS pollution when assigning categories of priority. Furthermore, the new ranking system considers whether water quality management tools and information are available to assess and correct the problem. This study focuses on New Mexico's new decision tree approach.

Indication of Problem

In the first step, EID develops a list of candidate water bodies that are impaired or are threatened with impairment based on either documented information or best professional judgement. Criteria for inclusion on this list include water quality standards violations, use impairment, and rapid watershed development that threatens water quality.

In the second step, the impaired or threatened water bodies are evaluated to determine if sufficient information exists to identify pollutant sources and assess water quality impairment. Where data are adequate, water bodies are analyzed further to determine their priority for implementation of water quality controls. The evaluation criteria for these water bodies are illustrated on the top limb of the decision tree in Figure 1. Where data are inadequate, water bodies are prioritized for the collection and analysis of water quality data. These criteria are illustrated on the bottom limb of Figure 1.

Ranking Water Bodies for Control Action

Frequent or Infrequent Standards Violations

EID considers standards violations to include violations of both numeric and narrative standards, as well as impairment or threatened impairment of designated uses. Standards violations are defined as frequent if, during the previous five years, 20 percent of the samples taken from a fixed monitoring station violate water quality standards. Where five years of monitoring data are not available, short-term intensive monitoring efforts may provide sufficient information to assess the frequency of violations. In these cases, EID relies on their water quality experts to determine whether the short-term monitoring effort is equivalent to the criteria established for fixed monitoring stations.

Even if standards violations are infrequent the water body could still be a candidate for management action. As can be seen in Figure 1, this depends on the waterbody's value and the existence of management tools to address the problem.

Waterbody Value

Impaired or threatened water bodies are given greater priority if they have a higher waterbody value. Water bodies with any of the following attributes are considered higher value:

- o domestic water supply;
- o wild and scenic river;
- o more than 5000 angler days per year;
- o endangered species habitat;
- o habitat for reproducing salmonoid population; or,
- o other significant recreational or ecological value.

Water bodies with infrequent standards violations and low resource value (see Figure 1) are ~~eliminated from~~ consideration. EID has found that two levels for resource value may be too crude a measure and that an additional level is needed, however, this has not yet been developed.

Availability of Management Tools

Greater priority is given to water bodies where problems can be addressed by the funds, best management practices, and program authority available to EID. The tools EID needs to correct a water quality problem depend on the degree and type of waterbody problem; the type, magnitude and distribution of NPS and point source pollution; and, the regulatory and non-regulatory mechanisms for addressing the problem. Treatment feasibility will also be a function of the biological and physical complexity of the water body and surrounding watershed.

Ranking Water Bodies for Data Collection and Analysis

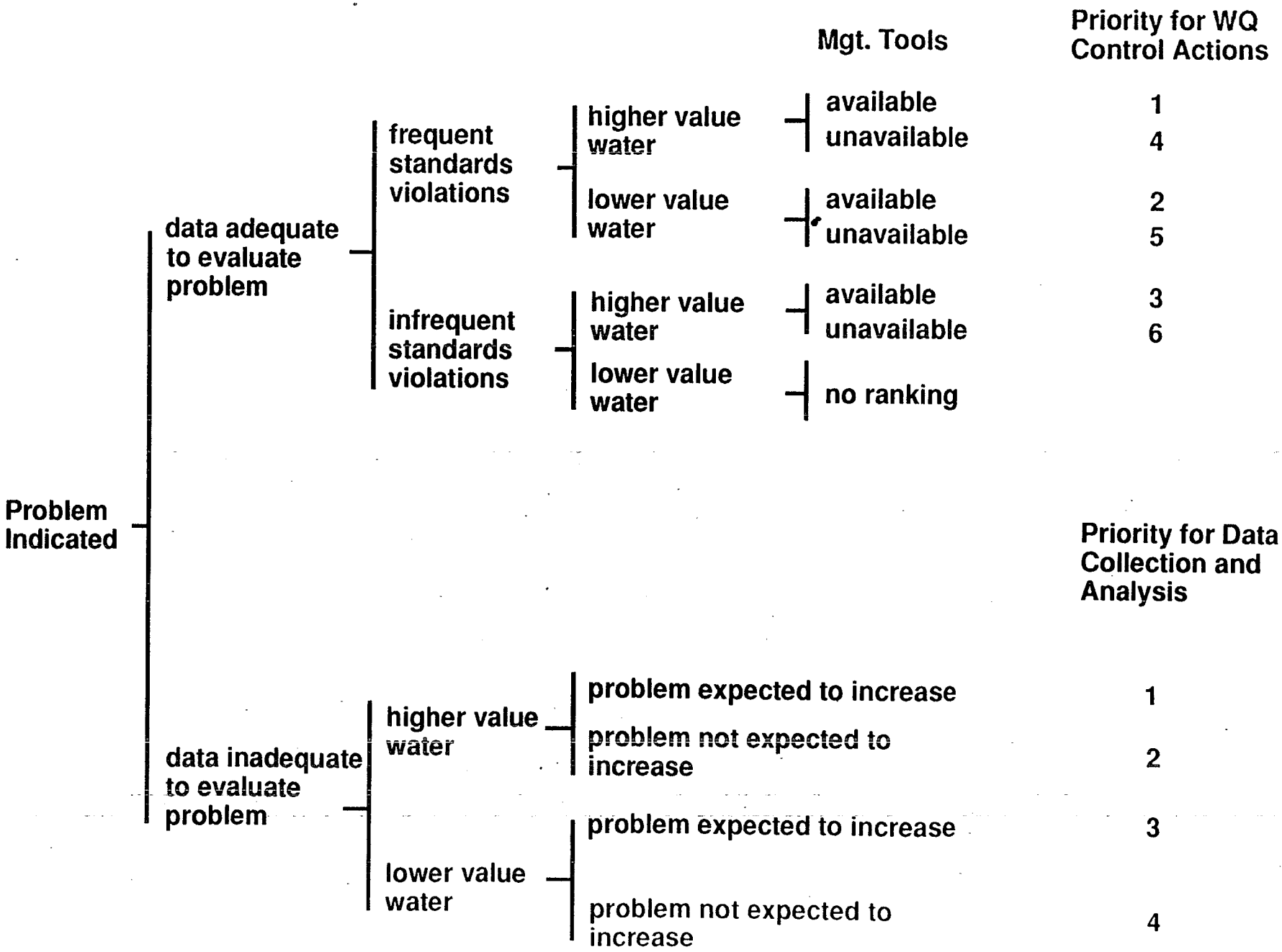
A water body may show signs of impairment, however, there may be insufficient information to evaluate the frequency of water quality violations, and to evaluate the type and quantity of management tools needed to address the problem. Where this information is lacking, the New Mexico priority ranking system helps focus information collection and analysis funds on water bodies most likely to respond to NPS control at a reasonable cost.

The lower limb of the decision tree in Figure 1 illustrates the evaluation criteria. Resource value is evaluated in the same manner as other candidates. In the second step, the water body is evaluated to determine whether the problem is expected to increase or decrease. Greater priority is given to water bodies where problems are expected to get worse. Criteria to consider include increased population growth or increased land use activities that disturb soil cover.

Reference

New Mexico Environmental Improvement Division. *Priority Water Bodies for Water Quality Management.* Sante Fe: September 30, 1988.

Figure 1
Priority Decision Tree



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RHODE ISLAND WATERBODY PRIORITY SYSTEM

Introduction

Rhode Island's Department of Environmental Management (RIDEM) has developed the following set of objectives for their 319 NPS Management Program.

1) Protection of waters that provide the greatest public benefit or have the highest ecological value.

2) Management of nonpoint sources that cause the greatest environmental/public health risk or pose the greatest potential threat.

3) Implementation of best management practices that offer the greatest benefits, with respect to their evaluated nonpoint sources of pollution, to Rhode Island's waters and have a high probability of success.

RIDEM has developed a methodology, consistent with these objectives, to rank water bodies that are identified as threatened or affected by nonpoint source pollution. Specific criteria have been assigned a numerical value within three categories. The numerical values reflect the potential degree of public benefit gained or the resource's value. The three categories in which each water body is first assessed are:

- drinking water supply;
- bathing and recreation resource; and
- fishery and habitat resource.

Each water body is evaluated for the public benefit categories that apply. One water body can be evaluated in more than one category, however, the scores are not summed across the categories. Instead, the water bodies in each category are ranked independently to eliminate subjective judgement that one use is of greater importance to the public than the other.

RIDEM's prioritization process encourages different state agencies or divisions to coordinate their available resources with the goals of the state's nonpoint sources management plan. The separation by benefit category distinguishes between water bodies which, because of their different uses, are typically managed by different state authorities. In addition, the criteria used in the Rhode Island evaluation was developed through consultation with other state agencies, in order to incorporate issues of statewide concern and thus target those water bodies which are of statewide importance.

Water bodies are also evaluated for severity of nonpoint source impairment or threat of impairment. Water bodies that are threatened by nonpoint sources are prioritized according to criteria pertaining to protection, or prevention of further degradation. Those water bodies impaired by nonpoint sources are prioritized using criteria pertaining to restoration.

The six lists developed as a result of RIDEM's prioritization procedure (i.e., drinking water supply/threatened water, drinking water supply/impaired water, etc.) contain numerical rankings of water bodies based on public use/resource value and the level of nonpoint source pollution problems. With the exception of one category (drinking water supply/impaired water which uses the top 40th percentile ranking), water bodies in the top 25th percentile of their categories are identified as high priority waters. These lists serve as a first cut in targeting water bodies for future nonpoint source management efforts.

Public Benefits

Drinking Water Supply

Water bodies designated as drinking water supplies are assessed according to their degree of public value. Existing water supplies receive more points than proposed supplies and primary water supplies receive more points than secondary water supplies. Higher priority is assigned to resources that serve larger populations (see Table 23).

Table 23
Drinking Water Supply Evaluation Factors and Scores

Evaluation Factor	Points
1. Existing water supply	
Primary	100
Secondary	50
Proposed water supply	80
2. Population served	
≥250,000	100
≥2,500 <250,000	80
<2,500	50

Bathing and Recreation

The evaluation factors for bathing and recreation assign greater priority to those water bodies that provide greater access and facilities for the public. Higher scores are assigned to water bodies with more facilities for swimming, boating, fishing, camping and parking. Furthermore, publicly owned facilities are assigned higher scores than private, restricted access facilities, as shown in Table 24.

Table 24
Bathing and Recreation Evaluation Factors and Scores

Evaluation Factor		Points
1. Beach Facilities	State	100
	Town	80
	Private	40
	No beach facilities	0
2. Boat Ramps, Marinas, and Piers		
State or town facilities with parking for	≥20 cars	80
	≥5 <20 cars	60
	<5 cars	40
Private boat ramp, marina, pier, or boat livery		30
No boat ramp, marina, pier, or boat livery		0
3. Shore Access, Parks, Campgrounds, Management Areas, or Open Space		
State or town facilities with parking for	≥20 cars	70
	≥5 <20 cars	50
	<5 cars	30
Non-designated public area		20
Private facilities		30
No shore access or facilities		0

Fishery and Habitat

Fisheries and habitats are evaluated for the aquatic life they support. In stocked freshwater fisheries, "put and grow" receives a higher score than "put and take" or those fresh water fisheries that are not stocked. Cold water, natural freshwater fisheries are given higher priority than warm water fisheries. A particularly high priority is given to those resources that support unique habitat such as endangered species or anadramous fish. Marine finfish resources are prioritized based upon their use, as are shellfish and crustacean resources (see Table 25).

Table 25
Fishery and Habitat Evaluation Factors and Scores

Evaluation Factor		Points
1. Stocked Freshwater Fishery	Put and grow cold water fishery	100
	Put and take cold water fishery	90
	Not stocked	0
2. Natural Freshwater Fishery	Cold water fishery or habitat	100
	Warm water fishery	80
3. Unique Habitat	Oligotrophic waters, endangered species, anadromous fish, migratory waterfowl habitat, etc.	150
	No unique habitat	0
4. Marine Finfish Resource	Commercial	100
	Non-commercial	80
	Breeding ground	90
5. Shellfish and Crustacean Resources	Shellfish Management Area Designation	
	Commercially Valuable Resource	100
	Unique Shellfish Resource	90
	Other areas of shellfish harvesting	80
	Shellfish breeding grounds	90
	Crustacean harvesting/habitat	100

Water Quality Potential

The second step in RIDEM's prioritization process divides each of the three resource value categories into two groups: waters threatened by nonpoint sources and waters impaired by nonpoint sources. Rhode Island has found the additional information provided by the categorization of threatened and impaired waters to be helpful when choosing nonpoint source control projects. Efforts to protect threatened waters are generally more cost effective than restoration projects and thus may be more readily implemented when funding is a limiting factor.

Protection of Threatened Water Bodies

Threatened water bodies that have a high risk of pollution are assigned a higher numerical value than those with a low risk. Conditions indicating high risk include: evidence of rapid development (which is reflected by the percent change in building permits issued by a town between 1980 and 1987), documented nonpoint source pollution that could degrade water quality, or a documented water quality problem.

The expected response to nonpoint source controls is also an important factor for evaluation. Surface waters with little development near the shoreline are thought to respond better to nonpoint source controls than surface waters with extensive shoreline development. As shown in Table 26, priority is assigned according to the percentage of undisturbed shoreline.

Table 26
Evaluation Factors and Scores for Threatened Water Bodies

Evaluation Factor	Points
1. Percent Change in Building Permits Issued by a Town, 1980-1987	
21-30%	100
11-20%	80
6-10%	70
0-5%	50
2. Documented NPS Pollution Sites or Problems	100
Unknown	50
3. Documented Water Quality Problem	100
Unknown	50
4. Percentage of Shoreline in Undisturbed State	
100%	150
<100% ≥50%	100
<50% ≥25%	50
<25%	0

Restoration of Impaired Water Bodies

For use impaired water bodies, higher numerical value is given to water bodies that show the greatest potential for response to nonpoint source controls. Response is shown by water bodies that: partially support designated uses (as opposed to those that do not support designated uses), are located in a town with a low population density, or have no point sources or a small degree of impairment caused by point sources (see Table 27).

Table 27
Impaired Waterbody Evaluation Factors and Scores

	Evaluation Factor	Points
1.	Designated Use Impairment	
	Partial support	100
	Non-support	50
2.	Population Density (population/mi^2)	
	$<500/mi^2$	100
	$\geq 500 < 2500/mi^2$	80
	$\geq 2500/mi^2$	50
3.	NPS Controls Sufficient to Improve Water Quality	
	No point sources or in-place sources (sediments or ambient pollutant concentrations) of pollutant causing impairment present	100
	Point sources or in-place pollution sources present and are estimated to contribute the following percentage of pollutants causing impairment:	
	<50%	80
	>50%	40
	Unknown	70

Reference

Rhode Island Department of Environmental Management, Office of Environmental Coordination. *Rhode Island's Nonpoint Source Management Plan* (Preliminary Final). Providence: October 1988.

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COLORADO WATERBODY PRIORITY SYSTEM

Introduction

The Water Quality Control Division (WQCD) of the Colorado Department of Health developed this nonpoint source priority mechanism in 1988 to meet the requirements of Section 319 of the 1987 Water Quality Act. Colorado's program prioritizes projects for funding, weighing tangible and intangible benefits, with the goal of directing funds towards the protection of high priority water bodies.

Projects are only ranked if they are listed in the *Colorado Nonpoint Assessment Report* and recommended for a management program. In addition, four requirements must also be met before projects are ranked:

- Matching funds must be available from another source, and a commitment for their use on the project must be documented. It is WQCD policy to limit state funding of any project to 50 percent;
- There must be a project implementation plan, noting the problem, lead agency for project implementation, and anticipated results;
- Problem assessment data must be credible, emphasizing monitored or "hard" data as opposed to evaluated or "soft" data; and
- A maintenance agreement, insuring that the project owners or managers will arrange for life maintenance of the improvements, is required.

Projects that satisfy these threshold requirements are ranked for funding consideration. Water bodies are first divided into two groups; projects with total costs greater than $50,000 are separated from those with total costs less than $50,000. This two tier system is intended to assure a mix of projects not favoring either high or low cost projects.

The ranking procedure gives two NPS priority lists, one for fundable and one for contingency projects. The fundable list contains those projects that have their funds and are ready to proceed. The contingency list has projects that will proceed if additional funds become available.

Projects are presented to WQCD and ranked once a year. If a project has not started within the year, it is reranked and may change priority depending on current criteria or competition. The yearly prioritization exercise provides an ongoing evaluation of statewide nonpoint source needs.

Project rank is based on the waterbody's beneficial uses and potential for restoration. The beneficial uses category determines how many beneficial uses are impaired, the severity of impairment, and whether it is a state or national priority water body. The potential for restoration category has two areas of review: the likelihood of success and the demonstration value of the project. Sixty points are available under each category, with a total of 120 points available to NPS projects. Final state funding priorities are determined by WQCD.

Beneficial Uses

Number of Beneficial Uses Affected

Priority is assigned to water bodies based upon the number of beneficial uses (agriculture, aquatic life, water supply, and recreation) that are impaired by nonpoint sources. Table 28 presents the number of points a project receives for each waterbody use that is affected.

Table 28
Number of Beneficial Uses Affected

Evaluation Factor	Points
One Use	4
Two Uses	6
Three Uses	8
Four Uses	10

Severity of Nonpoint Source Impacts on Beneficial Uses

The severity of impact on beneficial uses is quantified based on the number of miles of stream or the surface acres of lake or reservoir affected by the nonpoint source and the degree of impact (see Table 29). While a number of beneficial uses might be affected, only the most severely impaired use is evaluated.

Table 29
Severity of NPS Impact to Beneficial Use

Evaluation Factor	Weighting Criteria	Points
1. Low Impact- little evident impact to beneficial uses	a. <5 miles or 200 acres effected	1
	b. 5-10 miles or 200-2000 acres	3
	c. >10 miles or 2000 acres	5
2. Moderate Impact- some impact to beneficial uses, not severe	a. <5 miles or 200 acres effected	10
	b. 5-10 miles or 200-2000 acres	15
	c. >10 miles or 2000 acres	25
3. High Impact- beneficial use severely impacted	a. <5 miles or 200 acres effective	30
	b. 5-10 miles or 200-2000 acres	35
	c. >10 miles or 2000 acres	40

State and National Priority Water Bodies

The state and national priority evaluation provides recognition of the special status of certain waters or the special uses those waters provide. Waters of national priority must provide habitat for a threatened or endangered species, be located in a Wilderness Area, or be a Wild and Scenic River. State priority water bodies include Gold Medal Fisheries or Wild Trout Streams, State Parks or Recreation Areas, or waters classified by WQCD as high quality water bodies (see Table 30). It is possible that one water body could receive points for the national and state categories.

Table 30
State and National Priorities

Evaluation Factor	Points
National Priority	5
State Priority	5

Potential for Restoration

Likelihood of Success

WQCD reviews each project implementation plan to evaluate the likely effectiveness of the proposed project. The expected degree of effectiveness is the basis for prioritization, distinguishing between waters with low, medium and high severity of impairment from nonpoint sources, as shown in Table 31.

Table 31
Likelihood of Success if BMPs are Installed

Evaluation Factor	Weighting Criteria	Points
1. Minor improvements or beneficial uses maintained	a. low severity waters	4
	b. medium severity waters	8
	c. high severity waters	12
2. Partial restoration of use or reduction of severity	a. low severity waters	10
	b. medium severity waters	20
	c. high severity waters	30
3. Substantial restoration of use or reduction of severity	a. low severity waters	15
	b. medium severity waters	30
	c. high severity waters	45

Demonstration Value of Proposed Project

The educational value of the proposed project to other NPS sites in Colorado is considered by WQCD in the evaluation process. Priority is based upon transferability of a project's technology. As shown in Table 32, priority is based on whether project transferability is limited, moderate, or extensive.

Table 32
Demonstration Value of Proposed Project

Evaluation Factor	Points
Limited use of project technology may result	5
Moderate use of project technology may result	10
Extensive use of project technology may result	15

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